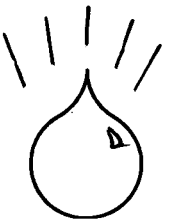


CITIZEN ACTION

Water quality is an issue of economic, social, and ecological importance. The ultimate goal of this manual is not only to increase knowledge and encourage environmental sensitivity, but also to foster personal responsibility and active participation in water quality protection within the local community.

The following activities promote water quality protection.

ADOPT A STREAM - STREAM WALK

By adopting a local stream, analyzing its watershed for potential sources of pollution, and periodically testing the water quality, students will discover first-hand how their community's activities impact water. Training for this activity can be obtained from the Kentucky Division of Water, Water Watch Program.

GRADES: 4-A*
SUBJECT: Art, Geography, Math, Science
SKILLS: Analyzing, applying, assessing, classifying, communicating, comparing, data collecting, describing, evaluating, interpreting, measuring, observing, recording, reporting, service-learning, small group work, writing
DURATION: 2 - 4 hours depending upon number of sites visited and number of tests conducted.
SETTING: Outdoors and indoors
KERA ACADEMIC EXPECTATIONS: 1.1, 1.2, 1.3, 1.5, 1.8, 1.10, 1.11, 1.12, 2.1, 2.3, 2.10, 2.19, 4.2, 5.1, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3

OBJECTIVES:

- To evaluate stream water quality.
- To draw conclusions about water quality based on observations, test results, and knowledge of local land-use activities.

METHOD:

Determine water quality of adopted stream using chemical tests and biological assessments. Identify possible sources of pollution. Recommend actions to prevent pollution from entering stream.

PROCEDURE:

- Adopt a nearby stream and locate accessible site(s) for investigation.
- Plan a field trip to the site(s), first getting permission from the landowner(s).
- Reschedule if:
  raining - test results may be inaccurate
  the water is rising - may result in dangerous flood conditions
  the combined air and water temperature is below 120 F - to avoid hypothermia.
- Have students wear waterproof boots or bring a change of sneakers - you will get wet!
- At the site(s), divide students into small groups.
- Have each group complete a test selected from the following pages. (Macroinvertebrate assessment muddies the water and should be conducted downstream from other tests or last, so as not to unfavorably affect the results of the other tests.)
- Upon returning to the classroom, create charts and graphs to display collected data; leave room for future investigations to be conducted monthly, seasonally, or annually.

EVALUATION:

This activity shows how nonpoint source pollution may be affecting water quality in the community.

- What can be concluded from the data about the water quality in the selected stream?
- Did all the tests come to the same conclusion?
- Which test(s) pinpointed problems?
- How can the problems be resolved?

EXTENSIONS:

- Bring trash bags and pick up any trash you may find. What is the impact of this trash on the water quality?
- Send test results to the Kentucky Water Watch program. How do your results compare with data collected by the state?
- Write and send articles to local newspapers about the activity.
- Report results and recommendations to local community leaders, local water protection groups, etc.
- Get involved with a local group for the restoration and protection of the water quality for the streams in your area.

* For Grades K-3 this activity can be conducted as an observation of stream habitat and surrounding area and/or "critter hunt" (see Stream Walk Tests - Habitat Assessment and Macroinvertebrate Assessment).

The following activities are different tests and investigations that can be conducted at the adopted stream.

STREAM WALK TEST - HABITAT ASSESSMENT

A habitat assessment determines the overall quality of the habitat for aquatic insects and other wildlife. It includes the measurement of certain stream characteristics and the evaluation of the watershed for potential sources of pollution (Kentucky Division of Water, 1997).

Significance habitat characteristics include:

- weather - heavy rainfalls may flood the stream sweeping aquatic life downstream and clogging the waterway with silt
- current velocity - different velocities provide habitat for different types of aquatic life
- overhead canopy - trees and shrubs provide food and moderate stressful temperature changes in the water
- river bottom composition - rubble and gravel provide habitat for the most diverse community of aquatic insects
- water appearance:

  clear - no apparent problem

  green - over abundance of plant growth due excess nutrients

  foamy - if greater than 3 inches high it may indicate the presence of detergents

  reddish - acid mine drainage or leachate from dump

  muddy or cloudy - siltation due to erosion

  tea - dyes from industry

  oily - oil floating on surface
- water odor:

  sewage - sewage discharges

  chlorine - over chlorinated wastewater treatment plant discharges

  fishy - excess algae growth or dead fish

  rotten egg - decomposing sewage

  acrid - industrial or pesticide pollution (Kentucky Division of Water, 1997)

MATERIALS NEEDED:

- Pencils
- Clipboards
- Worksheet - Habitat Assessment (one for each site)
- Thermometer
- Tape measure
- Topographic map of stream

PROCEDURE:

- In the classroom outline as much of the stream's watershed as possible on a topographic map.
- Plot known locations of possible sources of pollution within the watershed on the map. This would include farms, woodlands, urban areas, mining, industries, sewage treatment plants, construction sites, residential areas, etc.
- Based on observations at the site(s) and information from the map, fill out worksheet for each site.

EVALUATION:

- What types of pollution may be found (i.e. siltation, high nitrate-nitrogen content, etc.)?
- What conclusions about the condition of the habitat can be made from this assessment?
- How does this conclusion reflect on the water quality?

EXTENSIONS:

- Draw a diagram of the site showing: stream flow, habitat features listed above, significant vegetation.
- Write a description of the site from the recorded observations.

(adapted from Cole and Pauley, 1993; Kentucky Division of Water, 1997)

HABITAT SURVEY

RIVER BASIN:	STREAM NAME:	SUPERVISING SAMPLER:	DATE:
COUNTY:	SITE:	ADDRESS:	TIME:

GENERAL CONDITIONS

WEATHER	
	CLEAR / SUNNY
	OVERCAST
	SHOWERS

CURRENT	
	FAST
	SLOW
	STILL

TEMPERATURE	
	WATER
	AIR

RIVER BOTTOM COMPOSITION	
	BEDROCK
	BOULDER
	COBBLE
	GRAVEL
	SAND
	SILT

AVERAGE WIDTH	
AVERAGE DEPTH	

OVERHEAD CANOPY	
	FULLY SHADED
	PARTIALLY SHADED
	EXPOSED

LAND USE

	FORESTRY
	URBAN
	RESIDENTIAL
	COMMERCIAL
	AGRICULTURE
	GRAZING
	CROPS
	INDUSTRIAL
	MINING
	OTHER:

POLLUTION INDICATORS

WATER APPEARANCE	
	CLEAR
	OILY
	GREEN
	FOAMY
	REDDISH
	MUDDY
	TEA
	CLOUDY
	OTHER:

WATER ODOR	
	NONE
	SEWAGE
	OIL
	ROTTEN EGGS
	FISH
	CHLORINE
	ACRID
	OTHER:

POTENTIAL POLLUTION SOURCES

	BANK /CHANNEL ALTERATIONS
	STORM SEWER PIPES
	STRAIGHT PIPES
	WASTE WATER TREATMENT PLANT
	CONSTRUCTION SITES
	LOGGING AREAS
	NEARBY ROADS
	LIVESTOCK FEED LOTS
	LITTER
	OTHER:

OTHER

STREAM WALK TEST - CHEMICAL TESTS

Conducting various chemical tests is an important part of water quality monitoring. The simplest tests include pH, nitrate-nitrogen, and dissolved oxygen. Other tests that are available are total iron, chloride, free and total chlorine, and phosphate-phosphorous.

pH is a measure of the acidic or basic (alkaline) nature of a solution. The optimum range for aquatic life is a pH of 6-9. Fish avoid waters beyond these limits because it is too acidic or too alkaline (Kentucky Water Watch Program, 1993). Low pH levels in a stream can be caused by acid mine drainage or acid rain.

Nitrate-nitrogen occurs naturally in water from organic waste and nitrogen-containing compounds act as nutrients in streams. However, high levels of nitrogen can cause oxygen depletion which kills off aquatic life. Excess nitrates can be caused by municipal and industrial wastewater, septic tanks, feed lot runoff, and overuse of fertilizers on crops and lawns. The optimum range for nitrates is below 2 mg/l (Kentucky Water Watch Program, 1993).

Dissolved oxygen analysis measures the amount of gaseous oxygen dissolved in water. The greater the oxygen level in the water the more life the water can support. Low oxygen levels can occur from high concentrations of organic waste, ponding of stream flow during periods of low rainfall, and siltation. The optimum range for dissolved oxygen is above 7 mg/l (Kentucky Water Watch Program, 1993).

MATERIALS NEEDED:

- Disposable gloves
- Protective eyewear
- Paper
- Pencils
- Test kits - pH, nitrate-nitrogen, dissolved oxygen, etc. (information about these kits may be obtained from local Water Watch groups, County Extension Office, Natural Resource and Conservation Service (Soil Conservation Office), or from the Kentucky Division of Water, Water Watch Program.
- Empty milk/juice jug labeled CHEMICAL WASTE - for collection of treated water and used chemicals. **DO NOT** discard any chemicals or treated water onto the ground or into the stream. Contents of jug can be safely disposed of down the drain back in the classroom if flushed with lots of water.

PROCEDURE:

- Divide class into small groups, each group conducting a test.
- Follow test kit instructions carefully. It is best to have one student read the instructions and the others conduct the test. Make sure all equipment is clean and dry, especially the equipment used with chemical powders. Hold eye droppers and squeeze bottles vertical to get the correct drop size.
- Remember to discard all used chemicals and treated water in the jug marked CHEMICAL WASTE.
- Record test results.

EVALUATION:

- What conclusions about the condition of the stream can be made from the results of these tests?

(Adapted from Kentucky Water Watch Program, 1993)

STREAM WALK TEST - OPTICAL BRIGHTENER TEST

Optical brighteners in laundry soaps and detergents are fluorescent dyes that are used to make clothes seem whiter. When these dyes are found in surface water it usually indicates contamination from household sewage (Aley, 1995; American Cave Conservation Association, Inc. 1994).

MATERIALS NEEDED:

- 1/2 ounce of cotton (without optical brighteners)
- 1 piece wire, 3-4 feet long
- Distilled water
- 1 piece of 1/4" fiberglass mesh (screening)
- Ultra-violet light
- 3 large clear plastic bags

PROCEDURE:

- For control sample - place half of the cotton in one large plastic bag, add distilled water. Label bag "Control" and place in refrigerator.
- For test sample - fold the mesh in half and staple 3 sides. Insert rest of cotton into pouch and staple remaining side. Attach pouch to one end of the wire.
- At the stream site, anchor free end of wire to stream bank so that pouch is flushed with a large volume of water but will not be swept away. Leave in stream up to 5 days.
- After 4-5 days remove pouch from stream and place in large plastic bag. Place bag in refrigerator. To prevent contamination of sample do not let pouch touch any clothing.
- Vigorously spray pouch with distilled water. Carefully remove cotton from pouch and place in a clean plastic bag. In a darkened room, use an ultra-violet light to compare the cotton in the control and test bags. Optical brighteners will fluoresce or glow in this light.
- Record test results.

EVALUATION:

- Did the cotton from the stream fluoresce?
- How does the cotton compare with the clothes you are wearing?
- What conclusions about the condition of the stream can be made from this test?

(Adapted from American Cave Conservation Association, 1994)

STREAM WALK TEST - MACROINVERTEBRATE ASSESSMENT

Freshwater macroinvertebrates provide an excellent tool for water quality assessment. These organisms lack a backbone and are visible to the naked eye. In freshwater streams they include aquatic insects, crustaceans (crayfish, etc.), mollusks (clams and mussels), snails, worms, etc. Macroinvertebrates are restricted to their immediate aquatic habitat and cannot escape changes in water quality. If mild to severe pollution problems impact the stream, some taxa of these organisms will die and will not re-inhabit the area until the pollution is cleaned up. Therefore the relative abundance of these pollution tolerant or intolerant taxa can indicate the overall quality of the stream (Kentucky Division of Water, 1997).

MATERIALS NEEDED:

- Several large dip nets (10-12" wide aquarium nets or make own with pantyhose and hanger)
- Hand lenses (optional)
- Worksheet - Macroinvertebrate Identification Sheet
- Worksheet - Biological Monitoring Assessment Report Form
- Several collection pans: shallow plastic pans (white or light colored) **or** opaque white plastic bottles **or** aluminum pie pans, white enamel spray paint, and newspapers
- Optional: small paint brushes to remove critters gently from rocks, white plastic spoon for individual critter observation

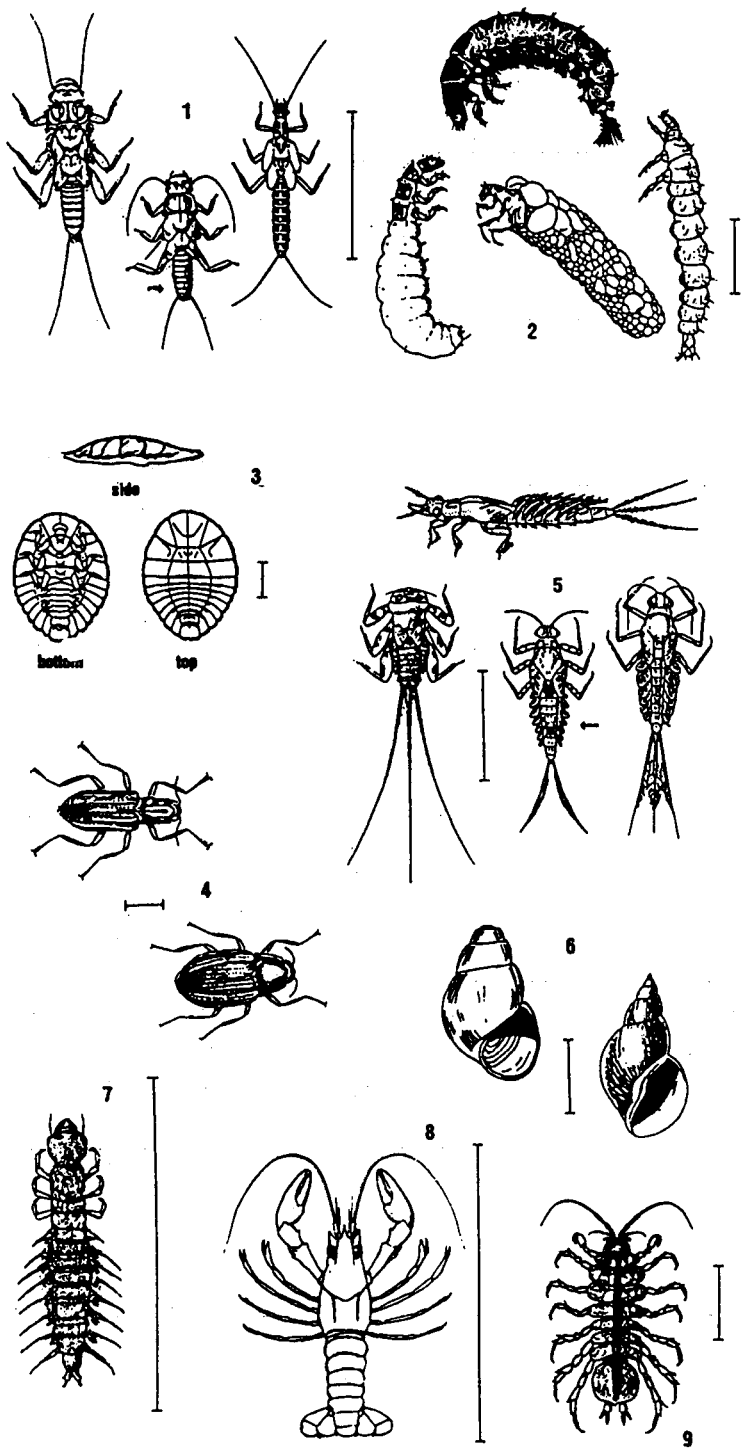
PROCEDURE:

- If using opaque white plastic bottles, clean thoroughly, and cut off top portion of bottle leaving a 2-inch deep dish.
- If using aluminum pie pans, place pans on newspaper and spray with white enamel spray paint, let dry completely before using.
- Do this activity last or downstream from the others.
- Fill collection pans 1-2" deep with creek water.
- Most critters will be found in riffle areas.
- Pick up rocks and check surface for clinging critters - most water pennies are found this way. Gently dislodge them and place in collection pans.
- While standing in the stream, hold the dip net on the stream bed downstream from your feet and scuff your feet to overturn rocks, dislodging critters which will then float into the net. Sort through the debris for critters and place them in collection pans.
- When collection is finished, identify and record the critters using the Identification Sheet and Biological Assessment Form. Do not wait too long before identifying critters; some critters may eat others before they are counted!
- When collection and recording is done, please return critters to the stream.
- Calculate biological index on report form.

EVALUATION:

- What group of taxa are most abundant in the stream?
- What is the biological index?
- What conclusions about the condition of the stream can be made from this test?

(adapted from Kentucky Division of Water, 1997; Tennessee Valley Authority)



Bar lines indicate relative size

Stream Insects & Crustaceans

GROUP ONE TAXA

Pollution sensitive organisms found in good quality water.

1 *Stonefly: Order Plecoptera.* 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 *Caddisfly: Order Trichoptera.* Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on lower half.

3 *Water Penny: Order Coleoptera.* 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs on the other side. Immature beetle.

4 *Riffle Beetle: Order Coleoptera.* 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 *Mayfly: Order Ephemeroptera.* 1/4" - 1", brown, moving, plate-like or feathery gills on sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 *Gilled Snail: Class Gastropoda.* Shell opening covered by thin plate called operculum. Shell usually opens on right.

7 *Dobsonfly (Hellgrammite): Family Corydalidae.* 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

Somewhat pollution tolerant organisms can be in good or fair quality water.

8 *Crayfish: Order Decapoda.* Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 *Sowbug: Order Isopoda.* 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

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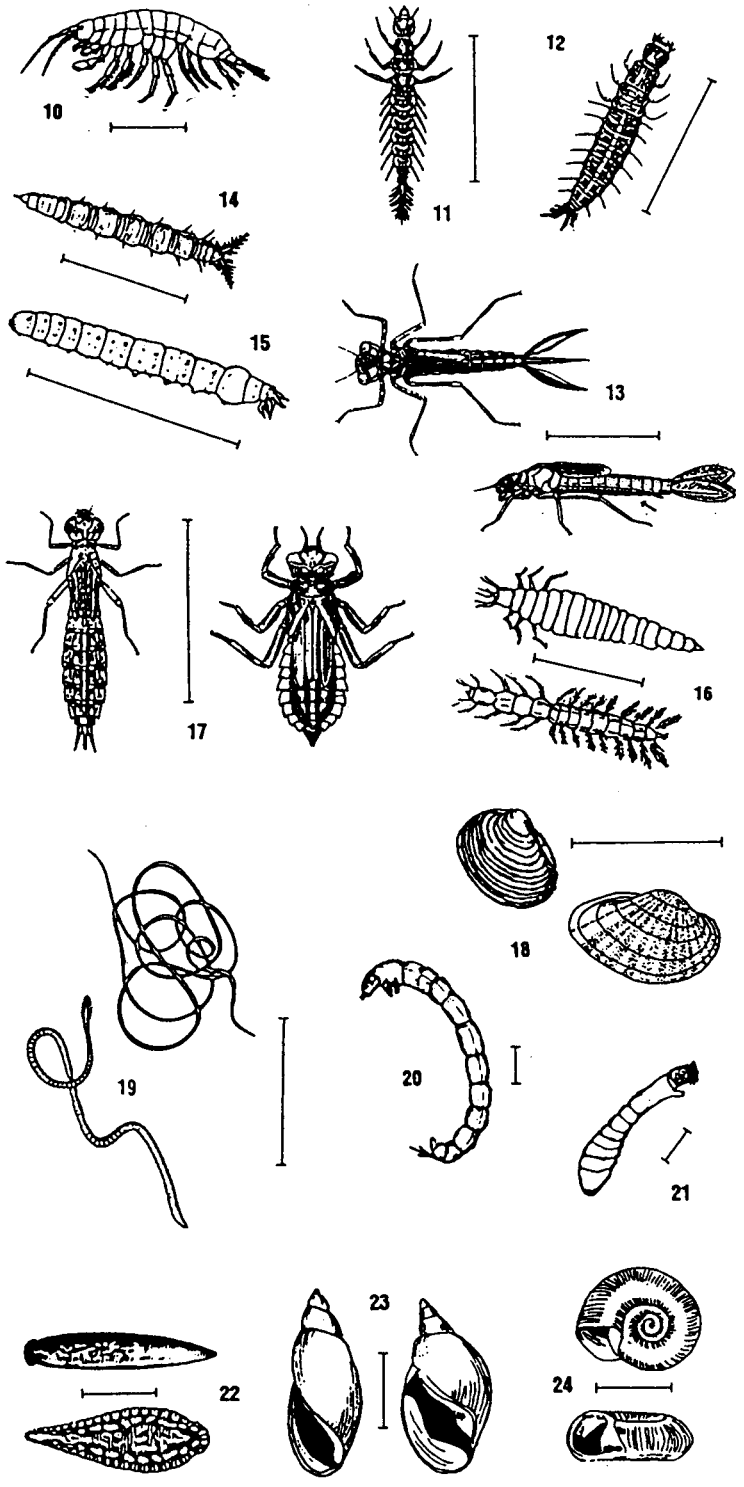


Bar lines indicate relative size

GROUP TWO TAXA continued

10 *Scud: Order Amphipoda.* 1/4", white to grey, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 *Alderfly larva: Family Sialidae.* 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 *Fishfly larva: Family Corydalidae.* Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 *Damselfly: Suborder Zygoptera.* 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 *Watersnipe Fly Larva: Family Athericidae (Atherix).* 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 *Crane Fly: Suborder Nematocera.* 1/3" -2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 *Beetle Larva: Order Coleoptera.* 1/4" 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 *Dragon Fly: Suborder Anisoptera.* 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 *Clam: Class Bivalvia.*

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 *Aquatic Worm: Class Oligochaeta.* 1/4" - 2", can be very tiny; thin worm- like body.

20 *Midge Fly Larva: Suborder Nematocera.* Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 *Blackfly Larva: Family Simulidae.* Up to 1/4", one end of body wider. Black head, suction pad on end.

22 *Leech: Order Hirudinea.* 1/4" - 2", brown, slimy body, ends with suction pads.

23 *Pouch Snail and Pond Snails: Class Gastropoda.* No operculum. Breathe air. Shell usually opens on left.

24 *Other snails: Class Gastropoda.* No operculum. Breathe air. Snail shell coils in one plane.

KENTUCKY WATER WATCH
BIOLOGICAL MONITORING ASSESSMENT REPORT

RIVER BASIN	DATE / TIME
STREAM NAME	SUPERVISING SAMPLER
SAMPLING SITE	ORGANIZATION
FLOW RATE 1._____Ponded 2_____Low 3_____Normal 4._____Bank Full 5._____In Flood	MAILING ADDRESS
AREA SAMPLED IN SQUARE FEET / NUMBER OF PARTICIPANTS	TELEPHONE #

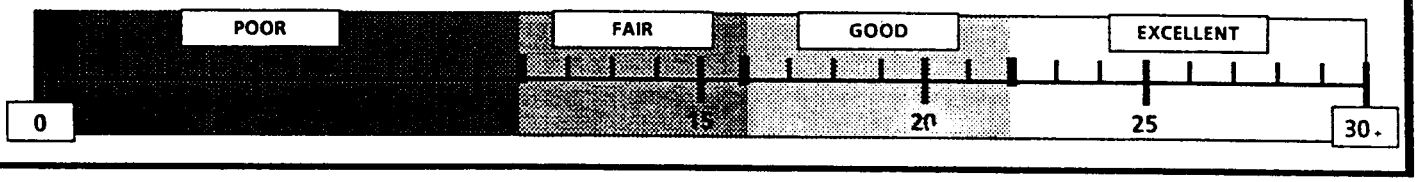
GENERAL DESCRIPTION OF WATER CONDITIONS

MACROINVERTEBRATE TALLY

GROUP 1 TAXA	CODE	GROUP 2 TAXA	CODE	GROUP 3 TAXA	CODE
WATER PENNY LARVAE		DAMSELFLY NYMPHS		BLACKFLY LARVAE	
MAYFLY NYMPHS		DRAGONFLY NYMPHS		AQUATIC WORMS	
STONEFLY NYMPHS		CRANE FLY LARVAE		MIDGE LARVAE	
DOBSONFLY LARVE		BEETLE LARVAE		POUCH SNAILS	
CADDISFLY LARVAE		CRAYFISH		LEECHES	
RIFFLE BEETLE ADULTS		SCUDS			
OTHER SNAILS		CLAMS			
		SOW BUGS / ISOPODS			
Number of taxa present		Number of taxa present		Number of taxa present	
Times index value of (3) =		Times index value of (2) =		Times index value of (1) =	

Cumulative Index Value	

BIOLOGICAL QUALITY ASSESSMENT SCALE



SEND REPORT FORM TO:

WATER WATCH
KENTUCKY DIVISION OF WATER
14 REILLY RD.
FRANKFORT, KY 40601
502-564-3410